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TAXONOMIC REVISION OF TWO POLYDORID SPECIES
(ANNELIDA, POLYCHAETA, SPIONIDAE)

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Polydora tricuspa Hartman (1939) is herein referred to the closely related genus *Boccardia*. *Polydora ciliata* (Johnston) var. *spongicola* (Berkeley and Berkeley, 1950) is herein raised to species status. Bases for the revision and further information concerning the morphology and geographical and ecological distributions of the species are presented below.

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Boccardia tricuspa (Hartman)

The single adult specimen originally described by Hartman was taken on the Presidential Cruise of 1938 at Sullivan Bay, James Island, Galapagos, in shore and tide pool collecting. She related this specimen to larvae found in the plankton at Scripps Institution of Oceanography at La Jolla, California (March–April, 1938), but was unable to find the adults in shore collecting at the latter region.

Hartman described the branchiae as being present first on segments posterior to the modified fifth (in this species on segment 7); this is the usual arrangement in members of the genus *Polydora*. The author found specimens at Morro Bay and Cayucos (central California coast) which agreed with the diagnosis of Hartman's species but small branchiae were found on segments 2, 3, 4, –, 6, and posteriorly (Fig. 1a). This information based on study of preserved material was corroborated by observation of live material taken on a subsequent collection. Specimens of this species in the Allan Hancock Foundation collections were made available by Hartman and comparative studies indicated the identical nature of the original and the Morro Bay–Cayucos forms; it was necessary then to remove the species to the genus *Boccardia* in which the appearance of branchiae on segments anterior to the modified fifth segment is a prime characteristic.

The specimens from Morro Bay agree with the original description in many respects and especially in the morphology of the two kinds of enlarged setae of segment 5 (Fig. 1b) and in the absence of notosetae

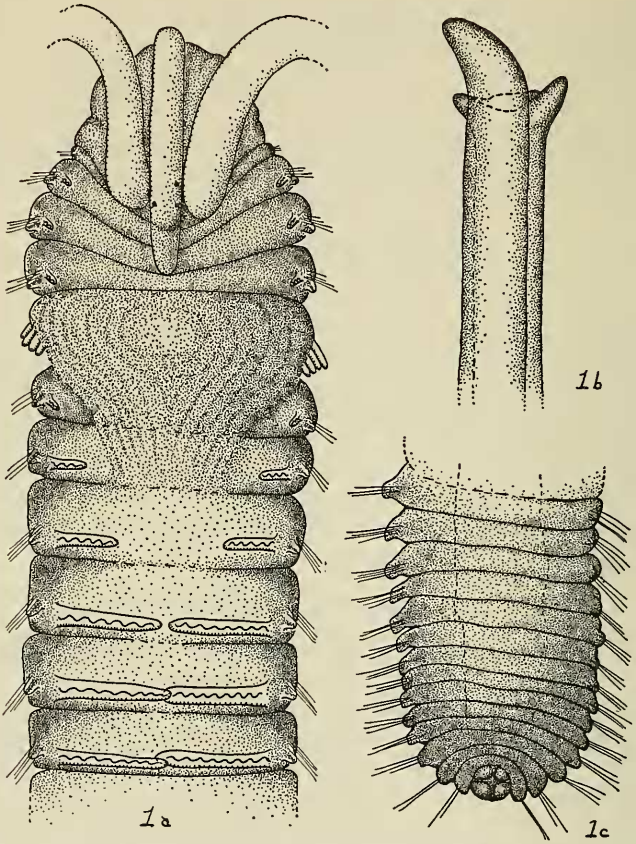

FIG. 1. *Boccardia tricuspa*—a, dorsal view of anterior end, × 35; b, modified seta of segment 5, × 300; c, pygidium, × 30.

in segment 1 of the adult. In describing the first setigerous segment of the larval form, Hartman (1939: 17) stated that it ". . . has both dorsal and ventral fascicles, the ventral setae much the shorter, and not present in the adult . . . ." In all other polydorids in which parapodial setae are absent in segment 1 of the adult, it is the notosetae which are so lost, and the neurosetae and lobe are shifted dorso-medially. This is suggested to be the case in *Boccardia tricuspa* after study of the Morro Bay form.

The specimens from Morro Bay–Cayucos differ from Hartman's original description in the branchial distribution and the posterior extent of the caruncle. The branchiae are present on segments 2, 3, 4, –, 6, 7 and about 10 more additional segments. From segment 6 through the next five or

six segments the branchiae gradually increase in size so that the tips, as they approach one another, form a V-shaped interbranchial space (Fig. 1a). The caruncle reaches only to the posterior border of segment 3 rather than segment 4. However, the latter segment is very narrow dorsomedially and exact determination of the posterior extent of the caruncle is not possible in all specimens. There are no anterior dorsal setae in the modified fifth segment (Fig. 1a). The pygidium (Fig. 1c), which was not described in the original work, is barely distinguishable from preceding segments and is unlike the disc-shaped pygidium found on most polydorids. The prepygidial segments are reduced in size; the last one is U-shaped and surrounds the small pygidium which opens dorsally between four weakly developed lobes.

The geographical distribution is extended from the original Galapagos Island and La Jolla, California, areas, north to Santa Barbara and the central California coast at Morro Bay–Cayucos.

The habitats of *Boccardia tricuspa* are made known here for the first time and include diverse situations. It was found in encrusting coralline algae (*Lithophyllum*) from the upper tide region and with a mass of serpulid tubes from the base of aggregated anemones (*Anthopleura elegantissima*). It occurred with sponge and with *Phragmatopoma californica* scraped from the surface of a rock from the lower tide region, a region of dense growth of *Postelsia palmaeformis*.

In the *Lithophyllum* it produced a clean burrow suggesting the ability to bore and erode the calcareous material. In this habitat it was associated with *Polydora ciliata* and a new species of *Polydora*, both able to bore through the algae, and with *Boccardia proboscidea* and *B. columbiana*; the latter two species, although able to erode calcareous materials, were found here more as nestling forms in accumulations of sand and silt between the algal lamellae.

Boccardia tricuspa was also a common inhabitant of gastropod shells inhabited by hermit crabs. In three separate collections at Cayucos of *Tegula brunnea*, with *Pagurus granosimanus* being the only associated hermit crab, the infestation rate was 11 of 42, 7 of 29, and 5 of 38 shells. The incidence of 21% indicated other than a chance occurrence in the shells. *Boccardia tricuspa* was associated in these shells with two other boring-type polydorids, *P. ciliata* and *B. columbiana*. At Santa Barbara *B. tricuspa* was found in *Ceratostoma nuttalli* as an associate with *P. commensalis*, in *Olivella biplicata* with *P. commensalis* and *P. ciliata*, and in *Thais emarginata* with *P. commensalis, P. ciliata, P. limicola*, and *B. columbiana*. All the Santa Barbara shells were inhabited by *Pagurus samuelis*.

Egg cases were found in material from Cayucos in late June 1961 and early July 1962 and 3-segment larvae within egg cases were also found in the June 1961 collections. A free-moving 17-segment larva was found in material collected 27 August 1961 at Santa Barbara. Hartman (1939) found 19-segment larvae in plankton at La Jolla during March–April

1938. It is possible that the reproductive cycle is initiated earlier in the warmer southern waters or that the data, when supplemented through additional collections, may indicate a continuous cycle with one or two peaks in reproductive activity during the year.

In the original description Hartman emphasized the fact that this species differed from other *Polydora* in having two kinds of stout setae in the modified fifth segment. Rioja (1939) noted in his description of *Polydora heterochaeta* that it also had two kinds of setae in the modified segment and he therefore established a section within the genus for the two species. As a result of the revision of *Boccardia tricuspa*, the position of *P. heterochaeta* should be reexamined. It was described from a post-larval stage, a stage in which the exact branchial distribution cannot always be determined. Other forms which should also be reviewed in this respect are *P. laticephala* and *P. punctata* described by Hartman-Schröder (1959). Each of these forms has two types of setae in segment 5; the former, which is very similar to *P. heterochaeta*, was apparently described from a larval form.

Hartman (1939: 17) stated in discussing the larvae taken at La Jolla, ". . . these pelagic larvae had up to 19 setigerous segments, indicating a long pelagic life, and hence the possibility of being widely disseminated by ocean currents." Egg cases observed in the present study were found only with 2- or 3-segment larvae, closely packed, with no nurse eggs present. This compares with the type of development described by Wilson (1928) for *Polydora ciliata*, in which it hatched at about the 3-segment stage and had a long planktonic existence. This supports Hartman's suggestion concerning the pelagic life of *Boccardia tricuspa*; however, the presence of larvae at La Jolla did not necessarily depend on their wide dissemination by ocean currents for, with the finding of adult *B. tricuspa* in many California coastal habitats, it is likely that the adults are present in the La Jolla intertidal in hermit crab shells and in encrusting coralline algae.

Settling of *B. tricuspa* may occur at approximately the 17-segment stage for a post-larval form of that stage was found associated with other polydorids in a *Thais emarginata* shell from Santa Barbara (27 August 1961). It had not lost the dorsal pigmentation characteristic of free-swimming larvae.

Polydora spongicola Berkeley and Berkeley

E. and C. Berkeley (1950) described *Polydora ciliata* var. *spongicola* as a new variety from sponges encrusting rocks at False Narrows and *Pecten hindsi* shells dredged in Northumberland Channel; both localities are near Nanaimo on the east coast of Vancouver Island.

They indicated that this variety differed from the stem species only in the form of the specialized hooks of segment 5. They stated (l. c.: 53), "It has also been found, together with representatives of the stem species, amongst bryozoa coating tubes of *Spirorbis*. This close associa-

tion of the stem species and the variety suggests that no more than phases of a single form may be involved." Because the setae of the fifth are so characteristic in *P. spongicola* and because of other morphological differences it is considered herein as a separate species.

Polydora spongicola and *P. ciliata* are compared below. Because *P. ciliata* has been described from many geographical and ecological areas, the comparisons made here are with that species as described by E. and C. Berkeley (1952).

The tip of the prostomium of *P. ciliata* is indistinctly notched; the prostomium in *P. spongicola* is rounded. In *P. spongicola* the palps are shorter and heavier (Fig. 2a). Neither species has notosetae on segment 1 but in *P. ciliata* the notopodial lobes are poorly developed compared to the other species. Segment 5 of *P. spongicola* is extremely well developed, overlapping segments 6 and 7. The large setae are very stout, having a heavy, falcate main fang with two lateral knob-like flanges which are joined by a raised collar located under the convex portion of the main fang. There is a third smaller knob slightly proximal to one of the lateral knobs (Fig. 2b). The main fang may show considerable erosion. Unlike *Polydora ciliata* the stout setae project freely from the lateral surface of the segment for quite some distance and there are no accessory setae.

The branchiae begin on both species at segment 7, but in *P. spongicola* they are very small on 7, intermediate on 8, and full-sized on 9 (Fig. 2a). They are present up to about the 10th last segment and are reduced to small, thin structures posteriorly. The pygidium of *P. ciliata* is described as cup-shaped, having a broad ventral rim which almost disappears dorsally (on the California specimens it is scoop-shaped). There is a dusky pigmentation on the pygidium, the anterior end, and the palps. In *P. spongicola* the pygidium is cuff-like (Fig. 2c) and is no greater in diameter than the last few prepygidial segments. It is refractile and in a few specimens had a brownish pigmentation at the edge. Most specimens possess a brownish anterior pigmentation beginning as a band across the dorsal surface of segment 5 and mid-dorsally on the next ten segments.

There is a variation in size between the two species, but while size may be a contributing factor in differentiation, it should not be the sole basis for separation. That size difference may be the result of ecological and other factors is emphasized in a comparison of specimens of *P. ciliata* and *P. spongicola* from British Columbia (specimens from E. and C. Berkeley) with those from California; specimens of both species from British Columbia are larger than their southern counterparts.

These morphological differences serve to separate the two species and support the contention that spatial relationship does not necessarily indicate taxonomic identity or even close relationship. *Polydora ciliata* is more similar morphologically to *P. hermaphroditica* Hannerz, *P. pacifica* Takahashi, and *P. websteri* Hartman, than it is to *P. spongicola.*

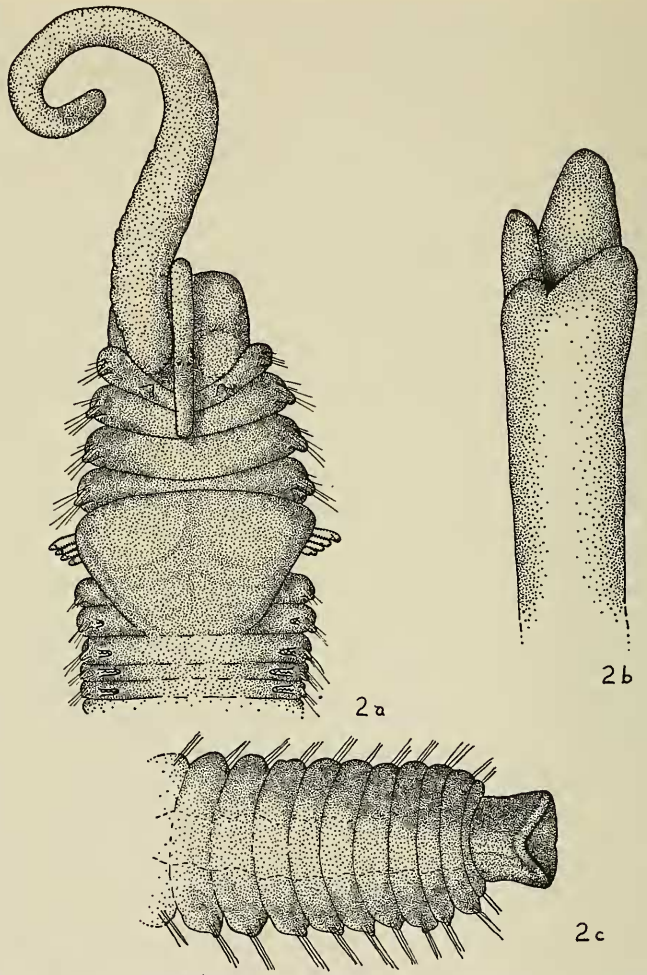

FIG. 2. *Polydora spongicola*—a, dorsal view of anterior end, × 30; b, modified seta of segment 5, × 300; c, pygidium, × 30.

The geographical distribution of *P. spongicola* (originally limited to the east coast of Vancouver Island) is herein extended to Trinidad Head in northern California, Cayucos and Avila in central California, and farther south at Santa Barbara.

Polydora spongicola is well named for in this study it was only found associated with sponge, a red encrusting sponge at Cayucos from the low tide zone near *Postelsia*, and a tannish-gray free-rolling sponge from the upper intertidal zone at Santa Barbara. It occurred in association

with *P. ciliata* at three of the six stations and with *P. limicola* at three of the six. However, only at Avila were all three found together. Study of these collections indicate *P. ciliata* has a broader ecological spectrum than *P. spongicola*, for while the latter was found only in sponge, the former was found there and also in gastropod shells inhabited by hermit crabs, debris from surface of low-tide rock along with *Phragmatopoma californica*, piling material, a *Dodecaceria* mass, *Macrocystis* holdfast, rock oyster shells, and coralline algae.

No reproductive material was found that could be associated unquestionably with *Polydora spongicola*.

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